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DEVELOPMENT OF AN INUNDATION MAPPING CAPABILITY USING HIGH RESOLUTION FINITE ELEMENT MODELLING

by

C. SMITH, P.D. BATES AND M.G. ANDERSON

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Professor M G Anderson

MISSOURI RIVER FLOOD MODELLING PROJECT

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Professor Malcolm G. Anderson

Department of Geography, University of Bristol, University Road, Bristol, BS8 1SS, UK.
Tel: +44-117-929-7875 Fax: +44-117-928-7878

SUMMARY

This document reports results derived from steady state simulations computed with a two dimensional finite element model of a 60 km reach of the Missouri River.

BACKGROUND

The aim of this project is to undertake a feasibility study into the potential utility of integrating high resolution two dimensional finite element flow models and Geographical Information System technology.

The initial phase of this research concerns the construction of an operational high resolution flow model for a 60 km reach of the Missouri River between Gavins Point Dam and Maskell gauging station.

This report contains a brief review of progress on this work unit during months 6-8 of the research contract.

CURRENT POSITION

A steady state computation has been established for the two dimensional finite element model developed in the first 6 months of this project. From this simulation the following conclusions can be drawn.

(i) The numerical model is computationally stable under steady state flow conditions. This has not previously been demonstrated for river channel simulations over such long reach lengths and as such represents a significant achievement. Experience has shown that if stable steady state conditions can be achieved then dynamic flow simulations are attainable. Dynamic flow simulations use a developed steady state as a starting point for the computation. We are thus in a position to move to this next stage, however a question arises concerning the current topographic representation (see Report no. 2: 1/5/95). This has been developed using data from 37 surveyed cross sections and incorporates a number of interpolation uncertainties. For this reason a dynamic simulation using this topography may not establish significant further information concerning the developed model. It is thus necessary to await the acquisition of the high resolution LIDAR topography before proceeding with dynamic simulations.

(ii) Mass conservation by the model is acceptable. Under steady flow conditions the difference between the imposed inflow boundary condition and the downstream outflow computed by the model can be used to give an accurate indication of the mass conservation properties of the scheme. This simulation indicates that mass conservation errors are less than $\pm 1\%$.

(iii) The model is fully capable of simulating dry banks, tributary inflows and zones of recirculation.

(iv) Computational requirements for the model will be high. This is a consequence of the large number of computational points used in the model and the length of the reach. This latter consideration is relevant if one wishes to simulate a complete flood wave passing through the reach.

During this period of research two other tasks have been completed. Firstly, USACE Missouri River District has been approached concerning gauge zero data and, secondly, USACE CRREL has been approached concerning the availability for use of the LIDAR high resolution topographic data set collected in late 1994.

FUTURE WORK

Future work will consist of four main tasks:

1. Refinement and testing of the numerical model.

2. Development of dynamic simulations using available flow data once LIDAR topographic data becomes available.

3. Selection and development of a simple hydraulic model for the James River (see Report no. 2: 1/5/95).

4. Development of a numerical model/ ARC INFO GIS interface.